

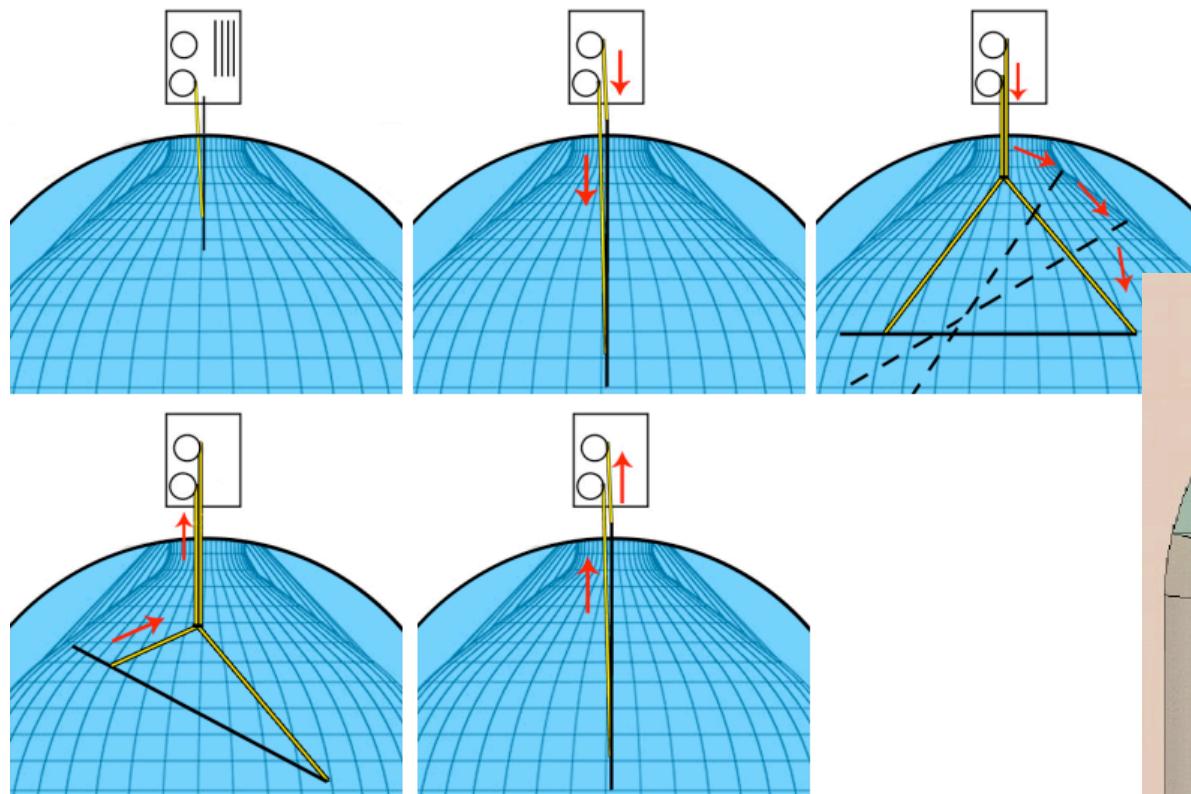
Status of the 4pi Full-Volume Calibration System

Karsten M. Heeger, *LBNL*

For the 4pi group

KamLAND Full-Volume Calibration

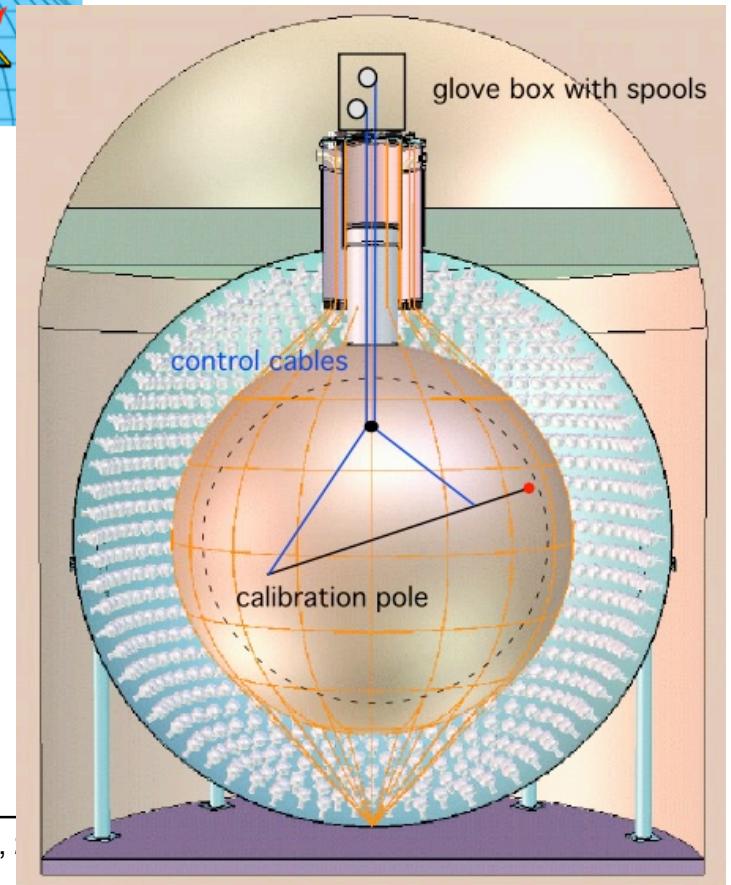
Calibration throughout entire detector volume



Fiducial volume: $R < 5.5$ m

$$\Delta R_{FV} = 5 \text{ cm} \rightarrow \Delta V = 2.7\%$$

$$\Delta R_{FV} = 2 \text{ cm} \rightarrow \Delta V = 1.1\%$$



Position Dependence of Detector Response

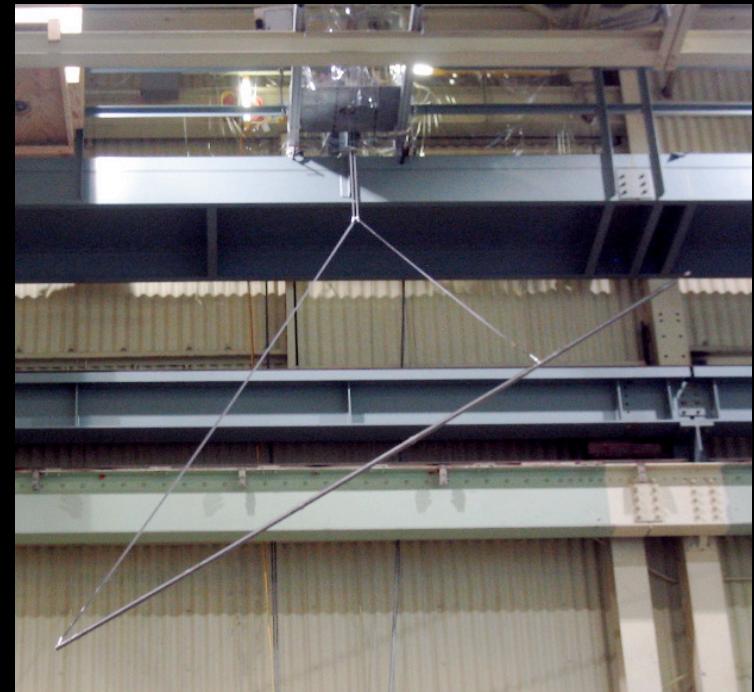
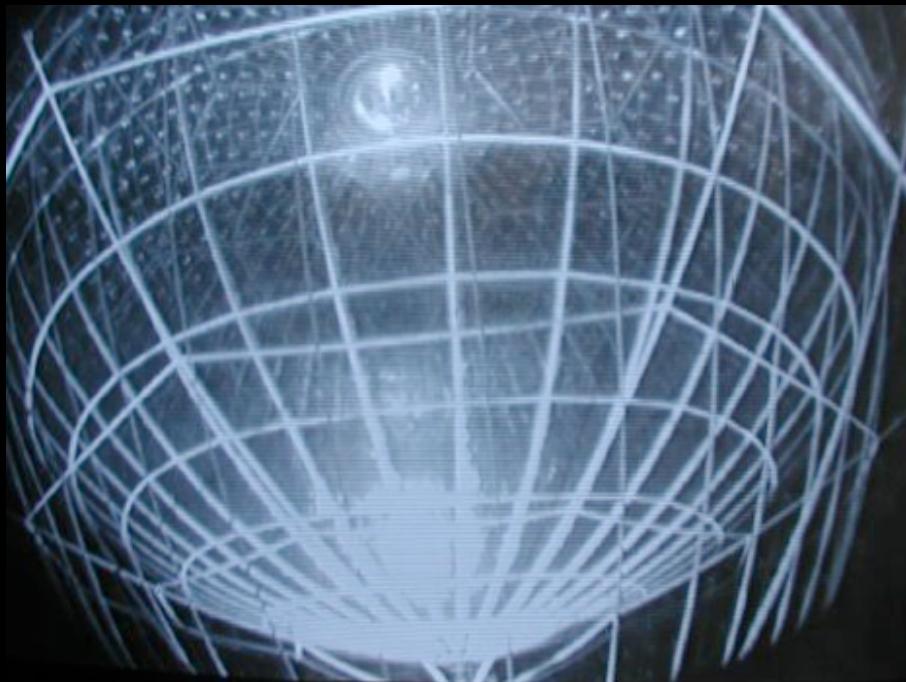
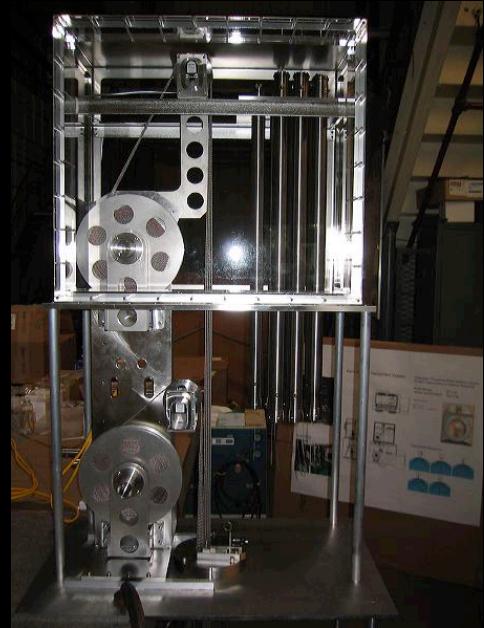
Event energy
Vertex reconstruction

$$E(r, \theta, \phi)$$
$$R_{fit}(r, \theta, \phi)$$

KamLAND Full-Volume Calibration System

Will reduce fiducial volume uncertainty:
4.7% → 1-1.5%.

Improves sensitivity to Δm^2_{12} (and θ_{12}).



Events Since Last Collaboration Meeting

Informal review of system by Marc Rosen in Nov 2004.

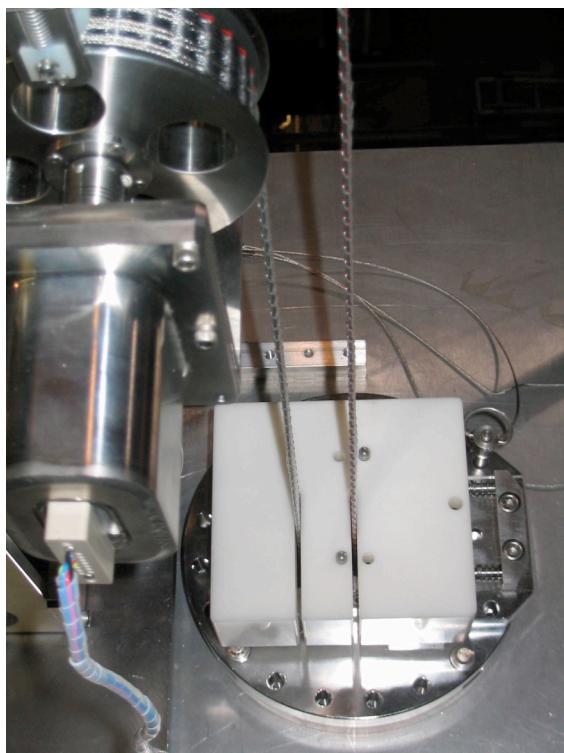
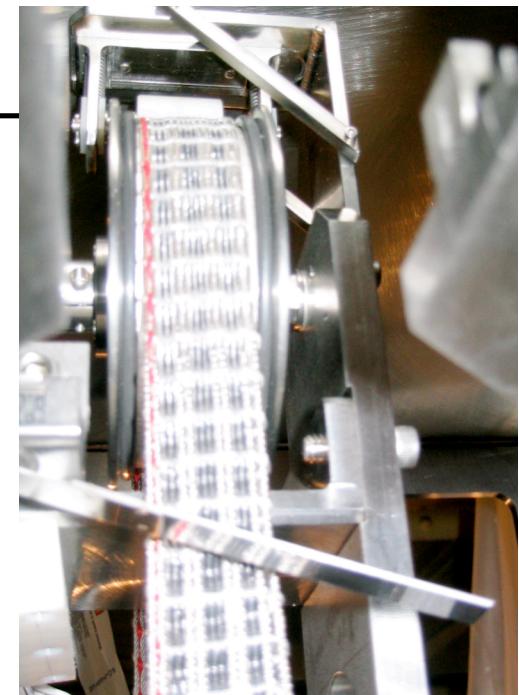
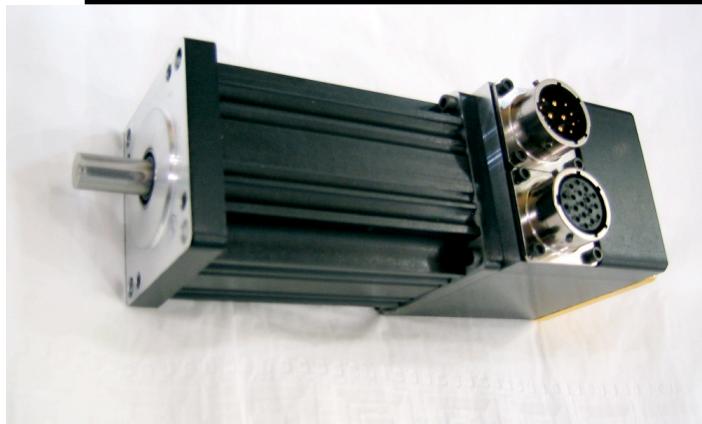
Continued testing and R&D. Optimized operation.

Replaced and re-worked several hardware parts.

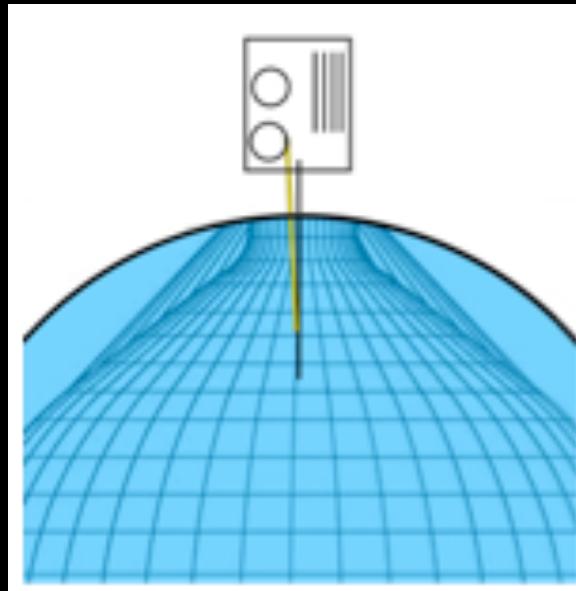
Studied recovery procedures in case of unusual circumstances.

Test deployment of instrumentation unit in KamLAND in March 04.

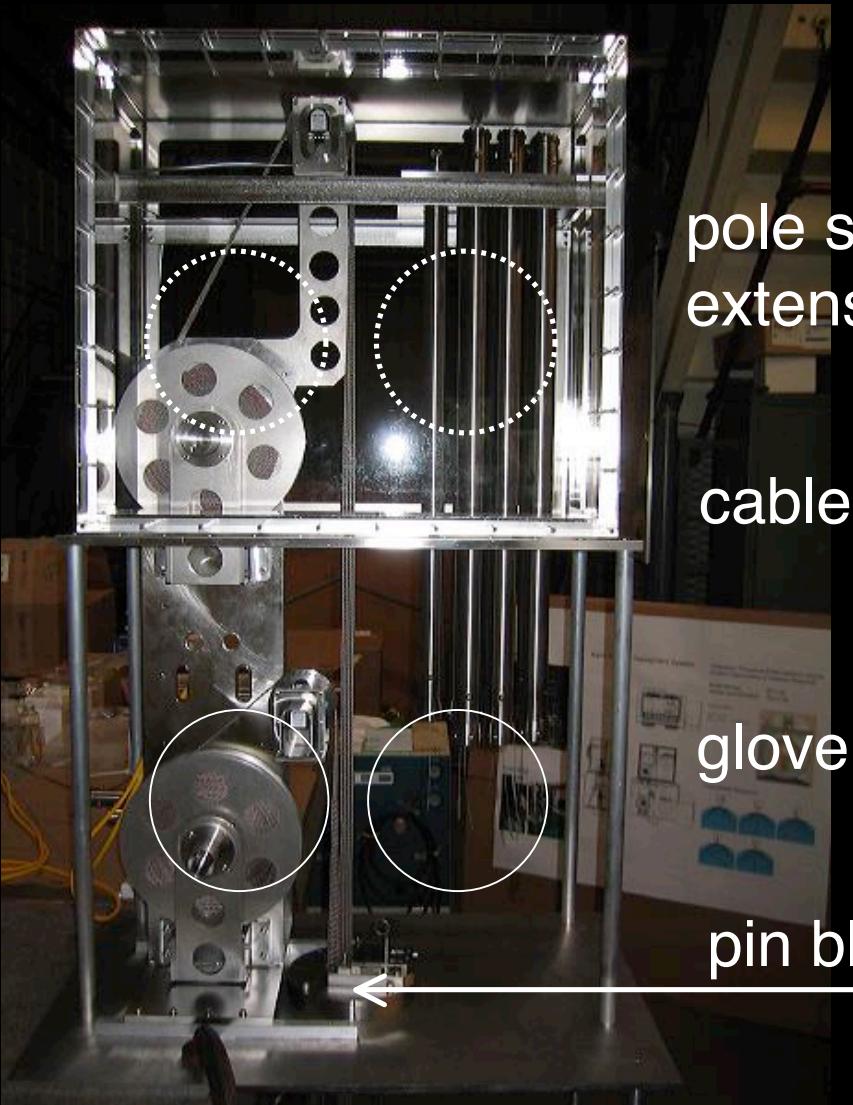
Some of the Hardware Improvements



KamLAND Collaboration Meeting, April 2, 2005



Assembly and Deployment



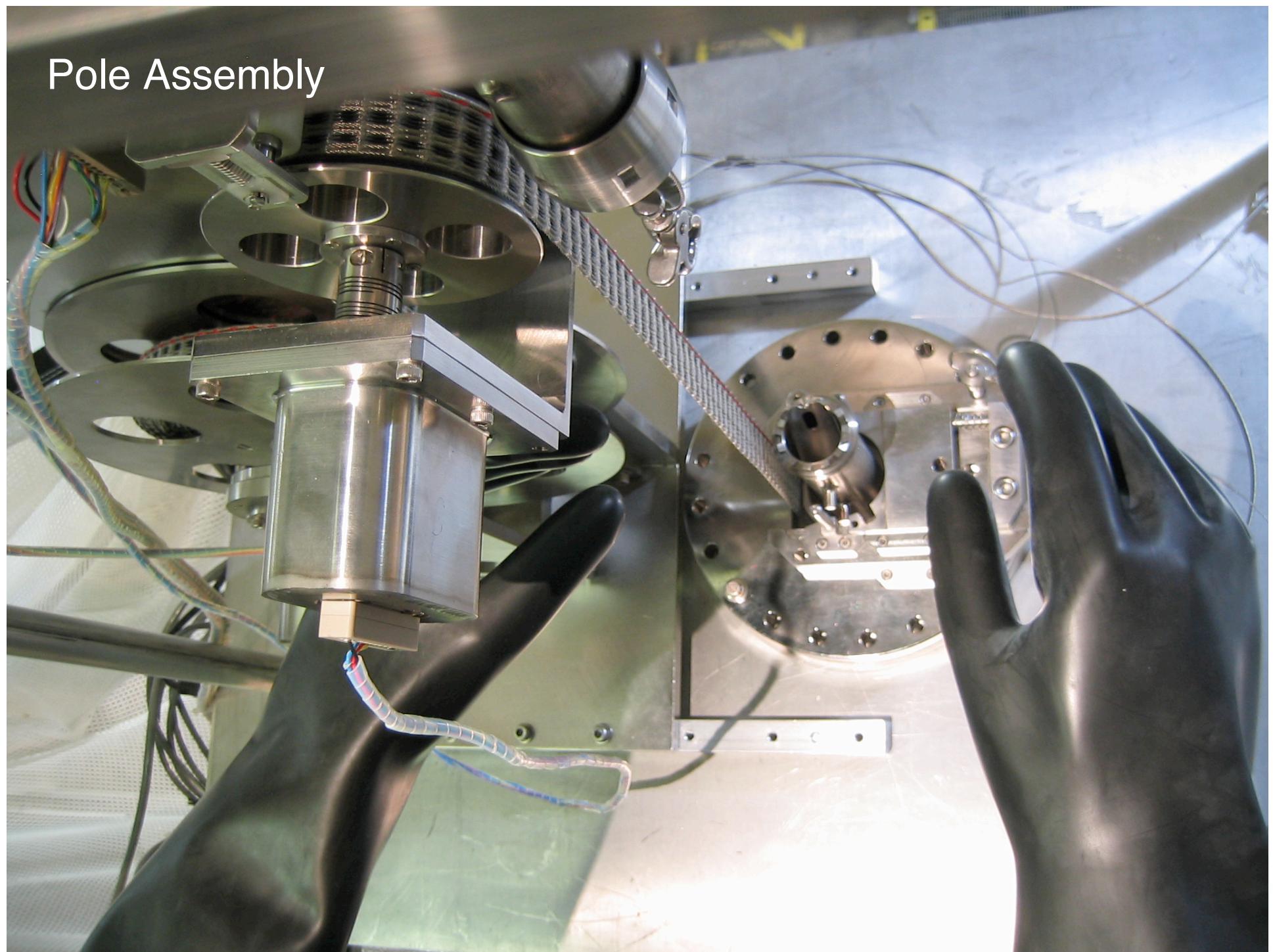
pole segments stored in glovebox extension

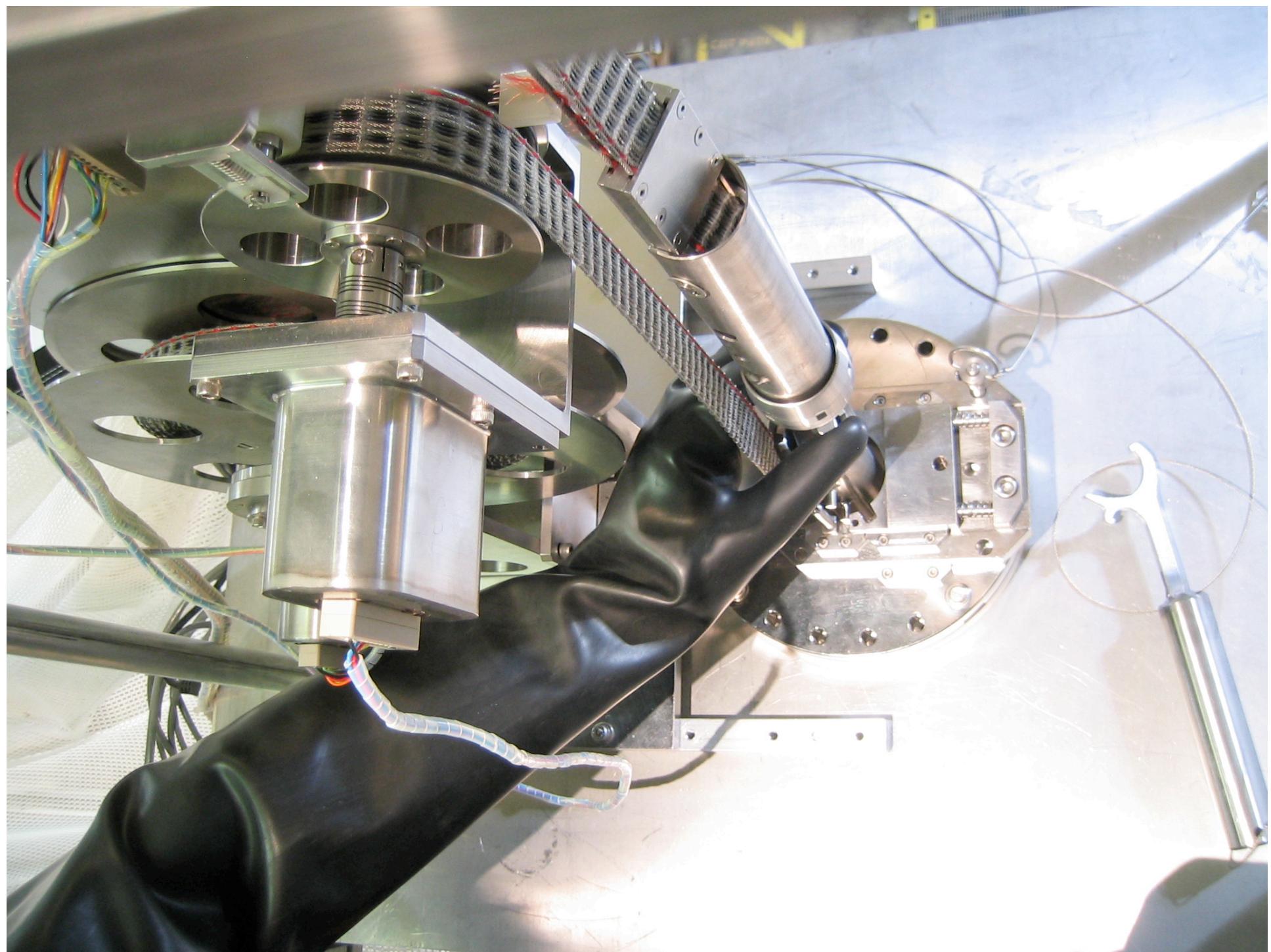
cable spools

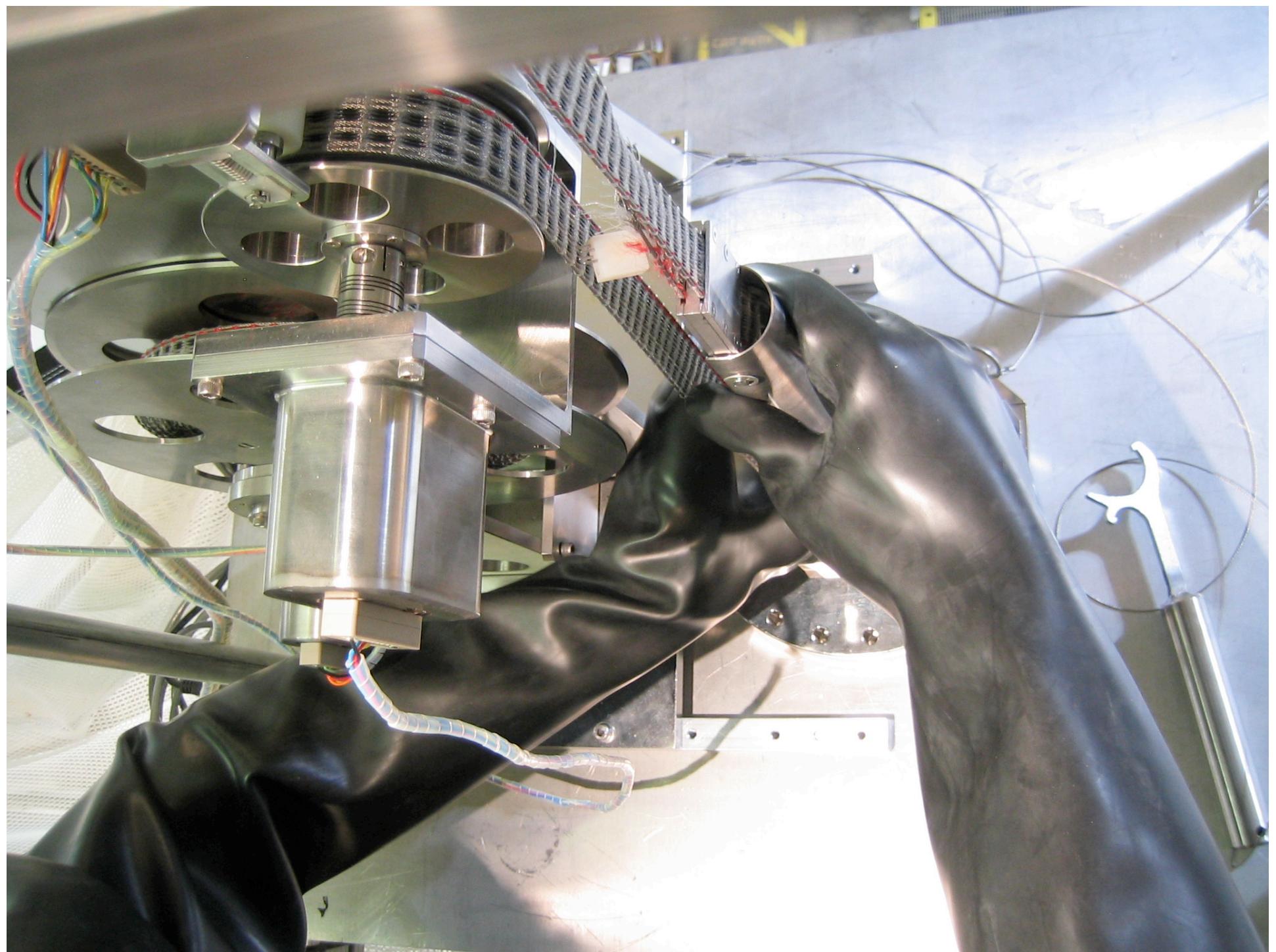
gloveports

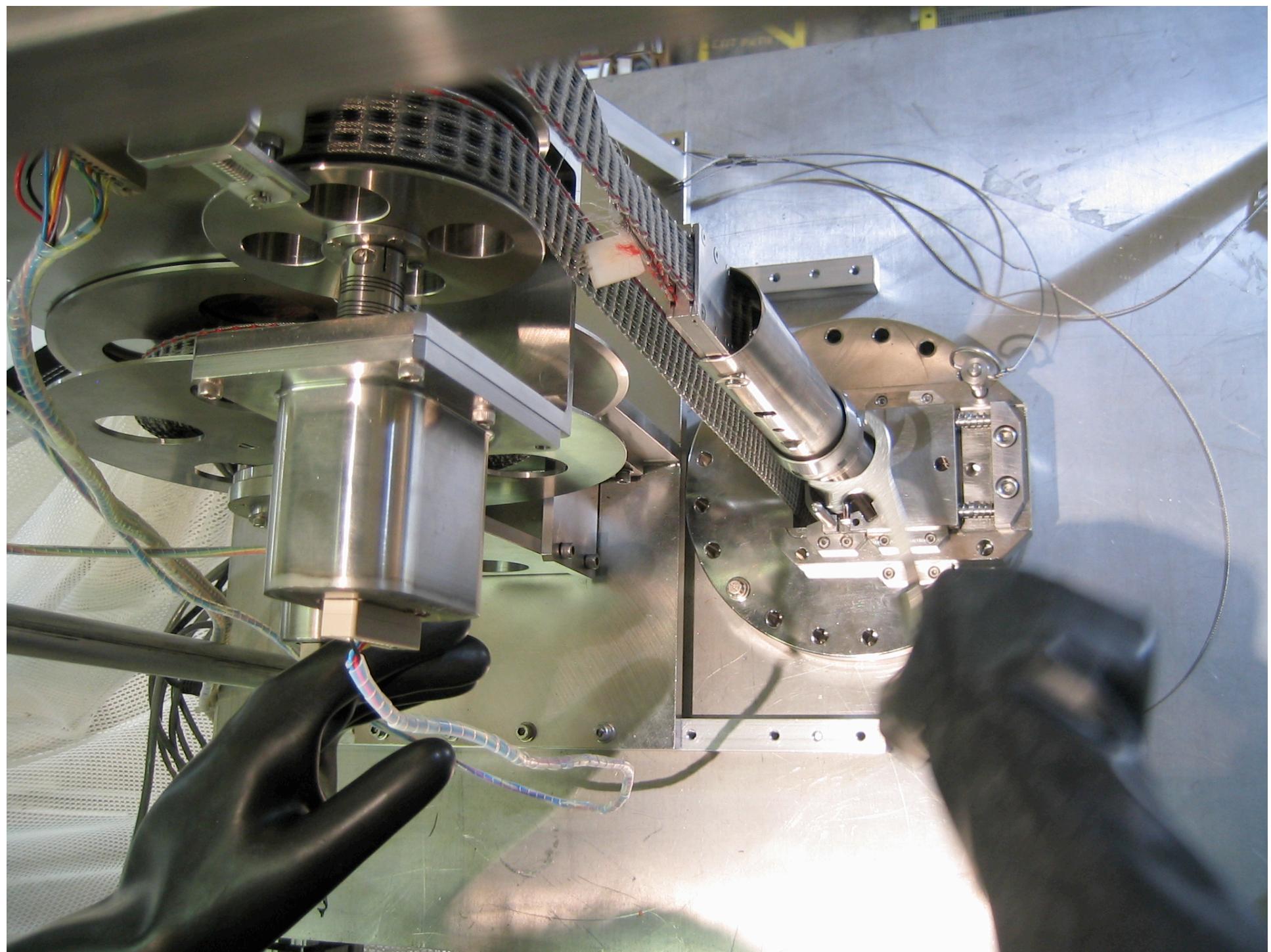
pin block

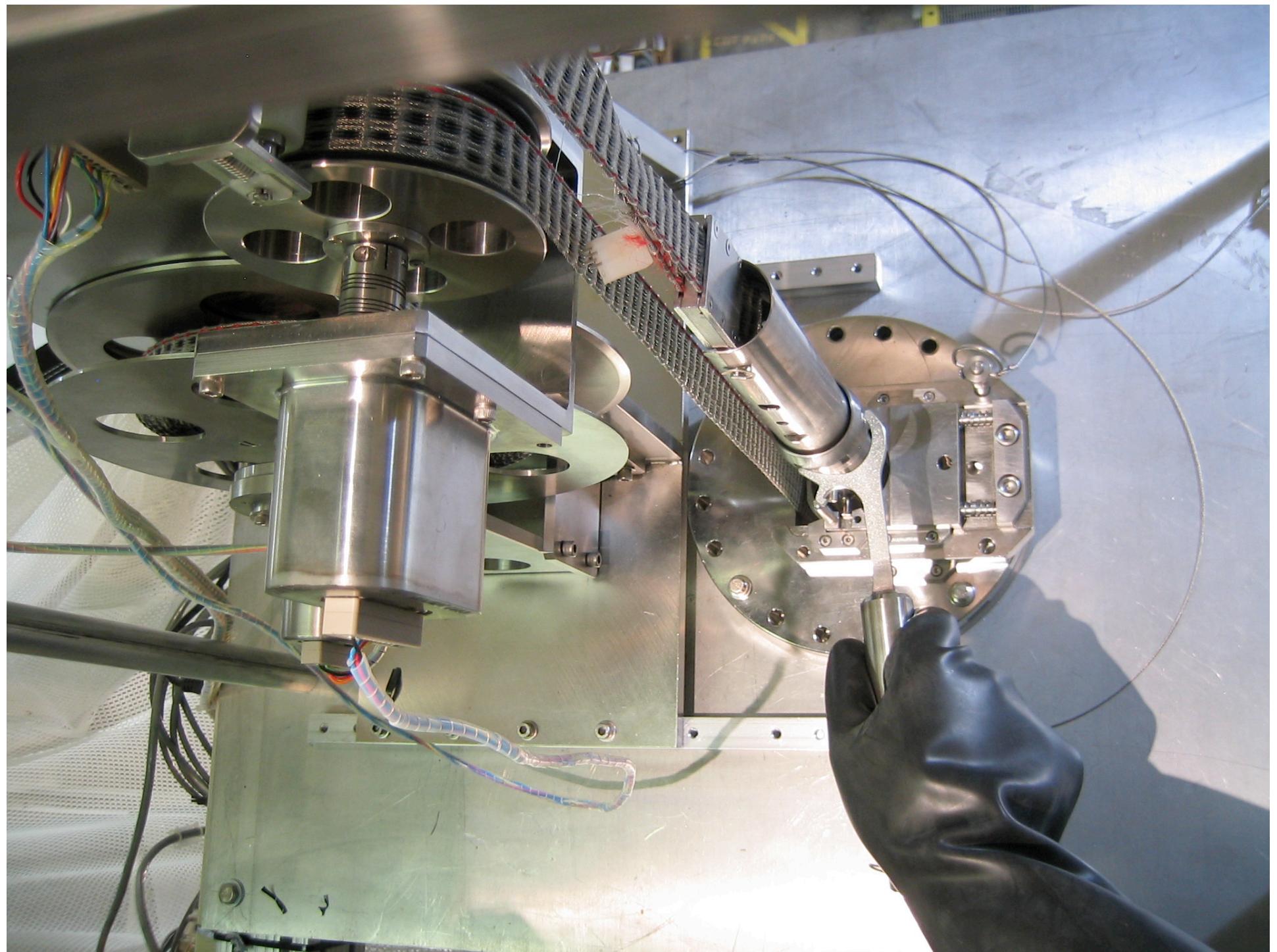
Pole Assembly



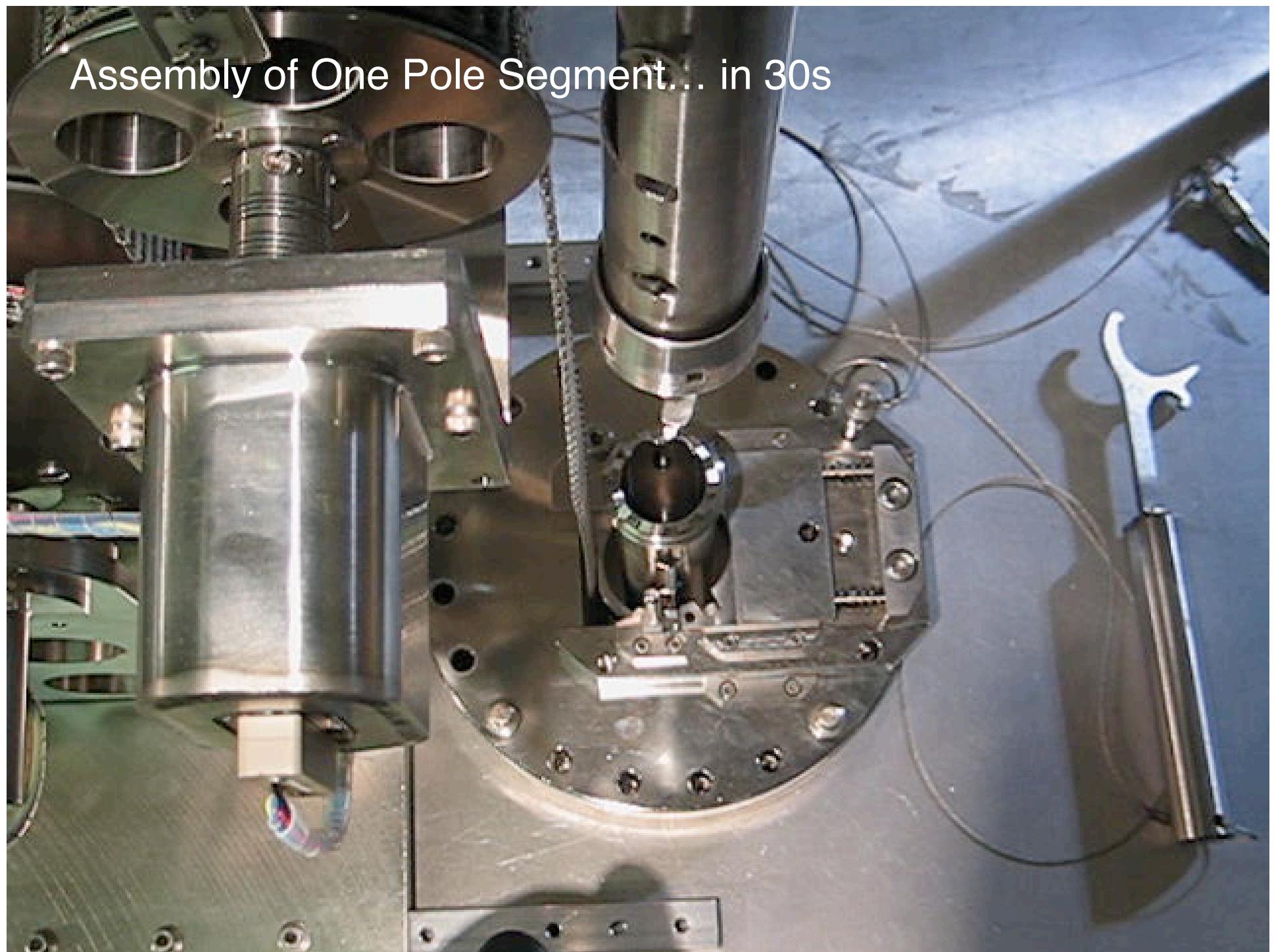




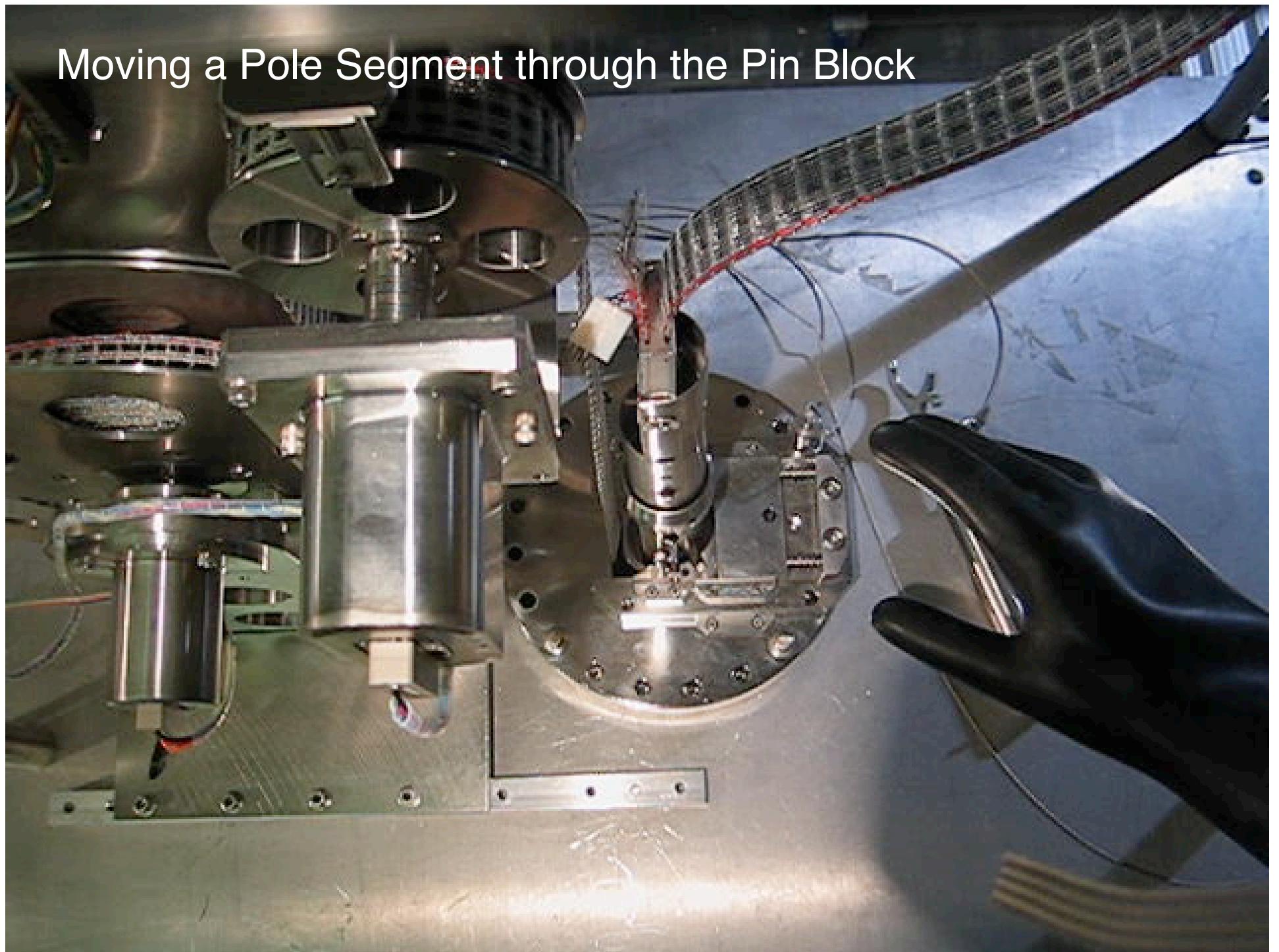


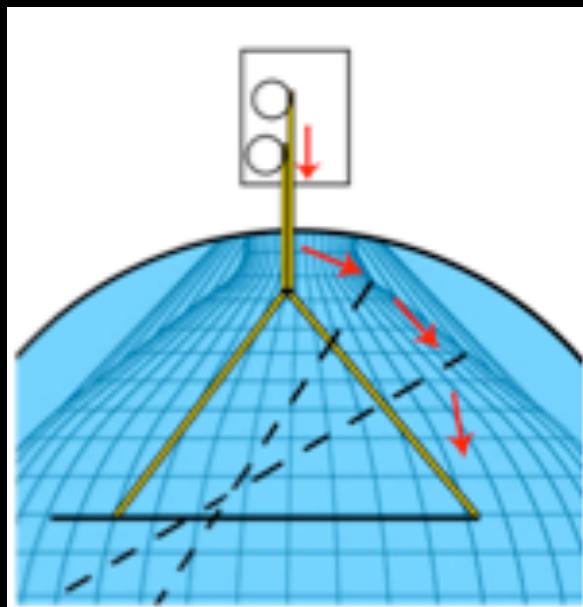


Assembly of One Pole Segment... in 30s



Moving a Pole Segment through the Pin Block



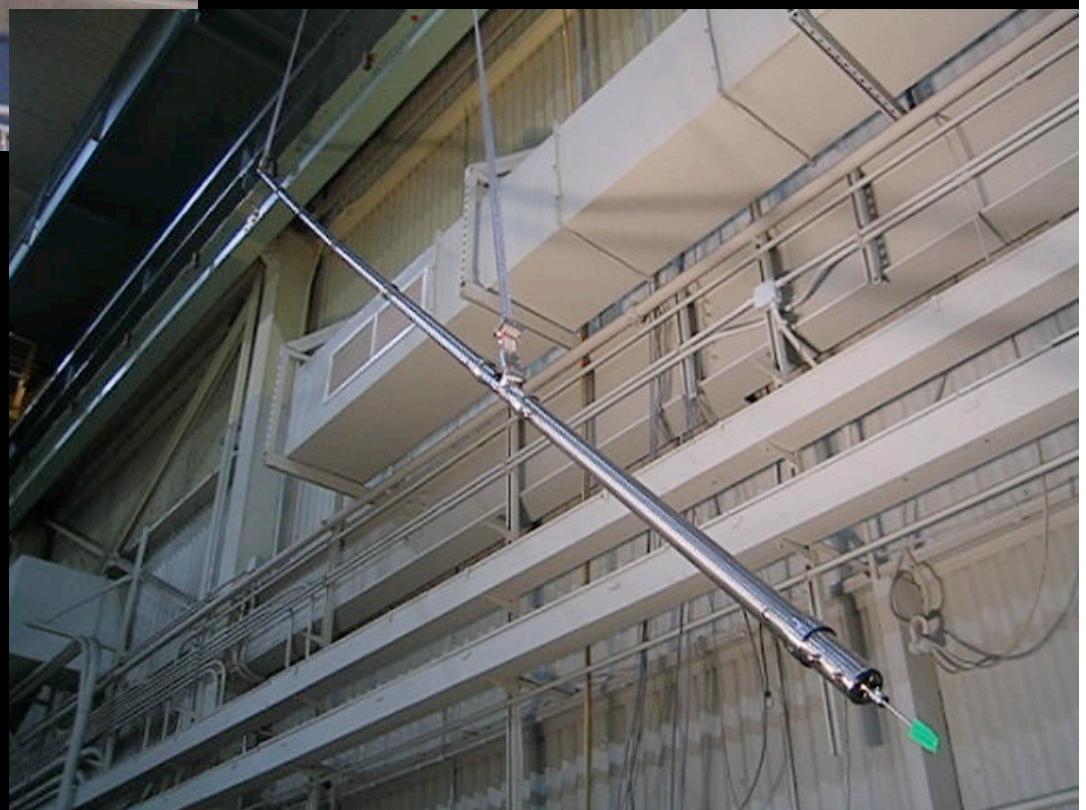


Moving into Position

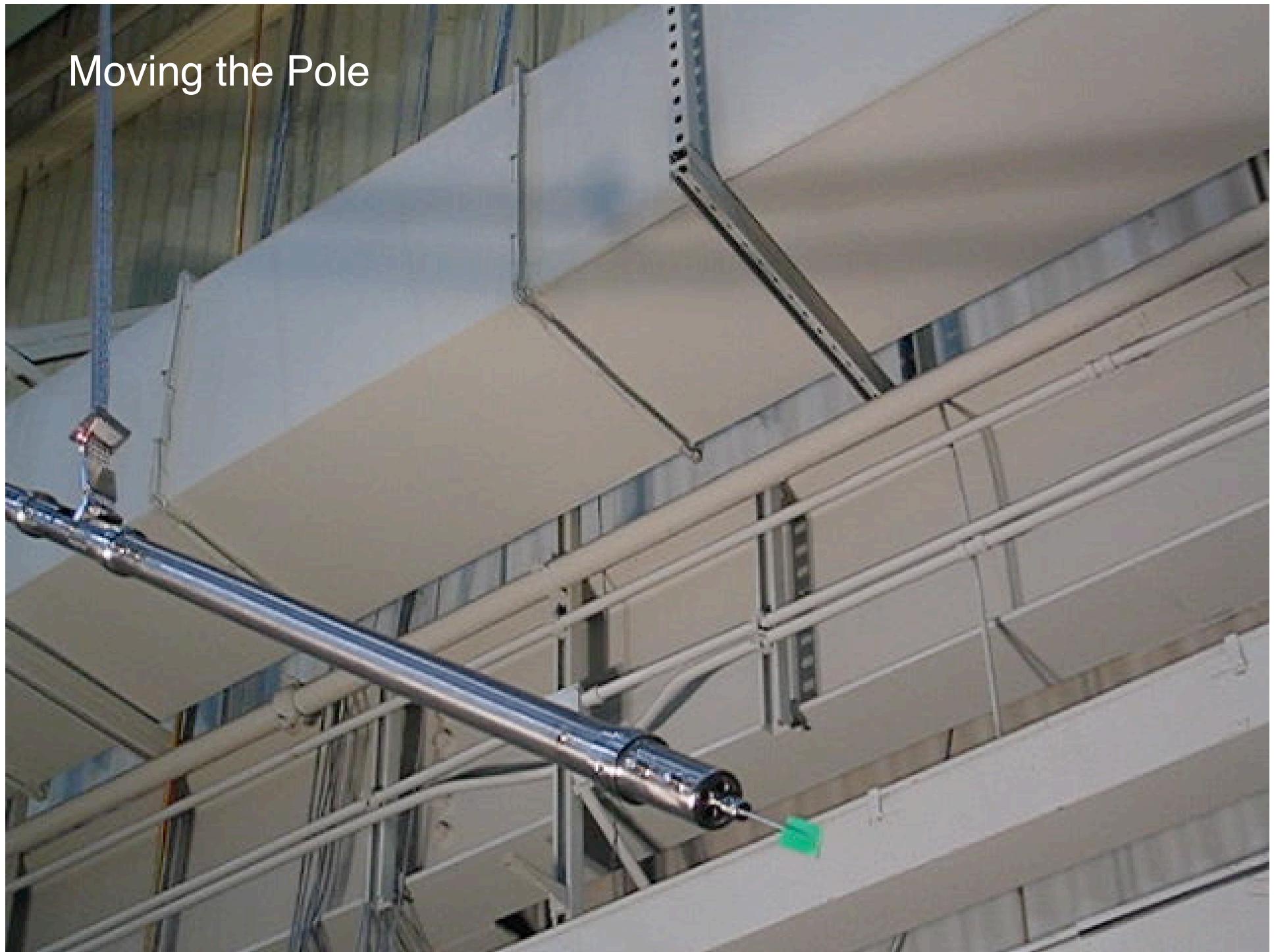
Moving the Pole in Position



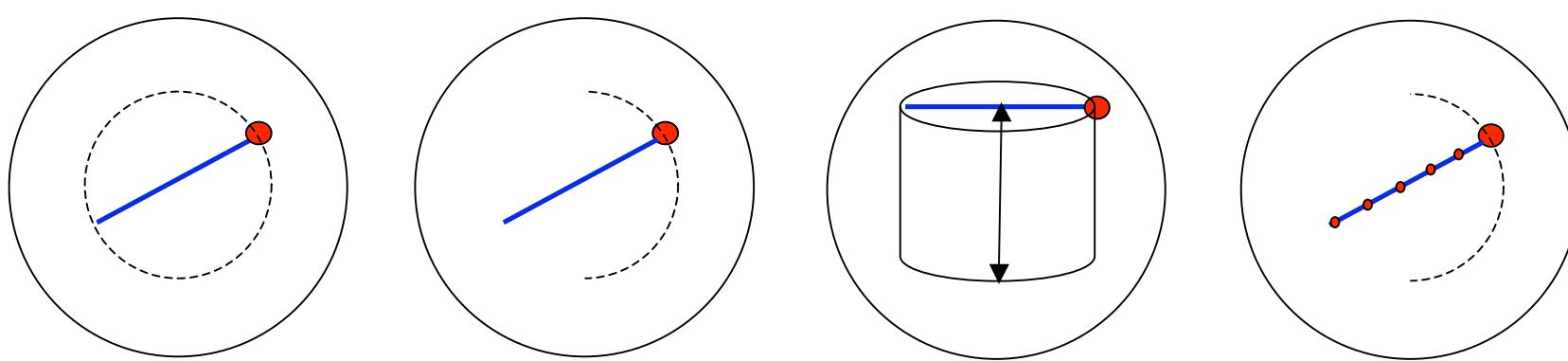
Moving the Pole



Moving the Pole

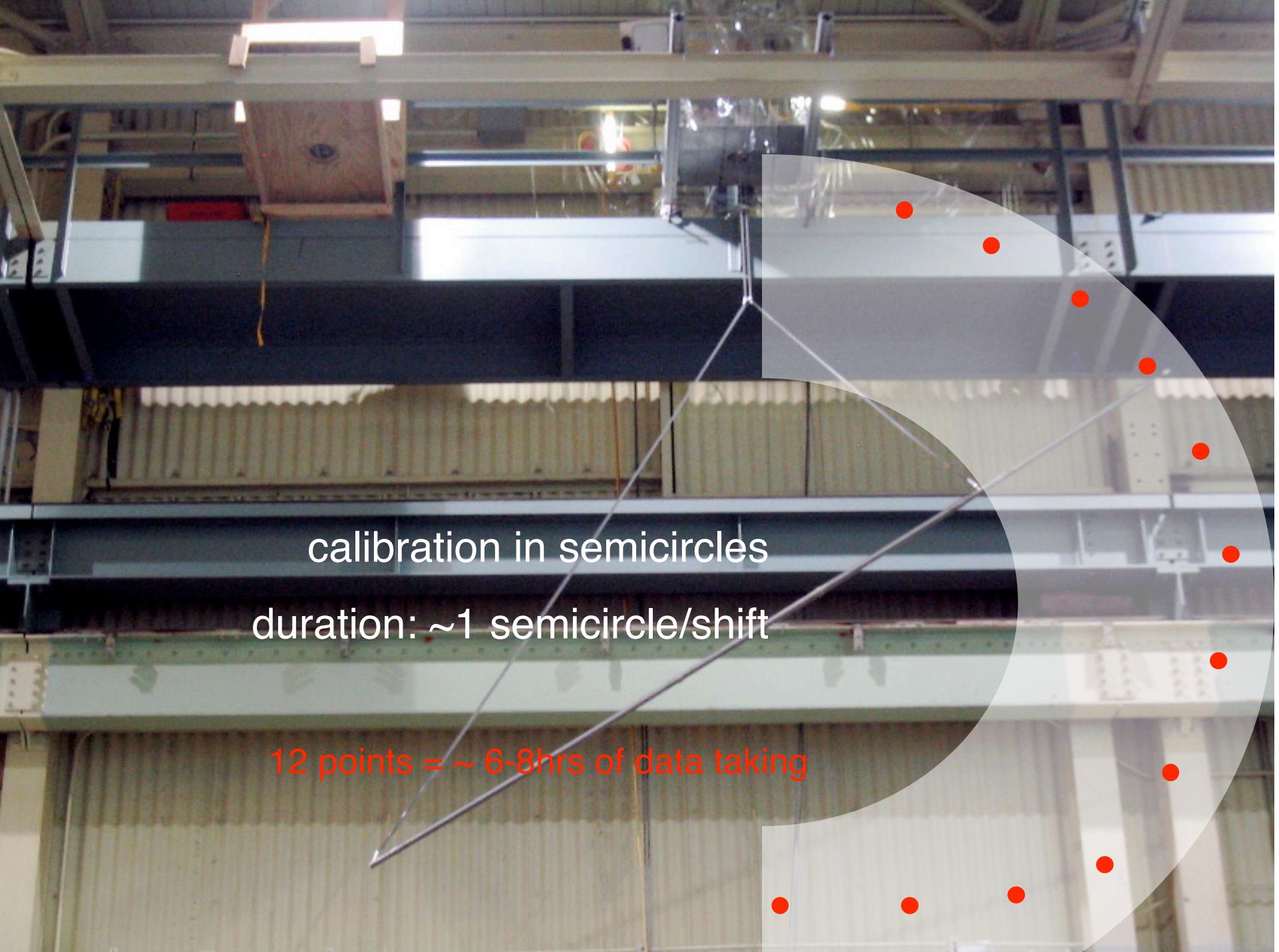


Possible Calibration and Deployment Scenarios



Optimized for ease and safety of operation

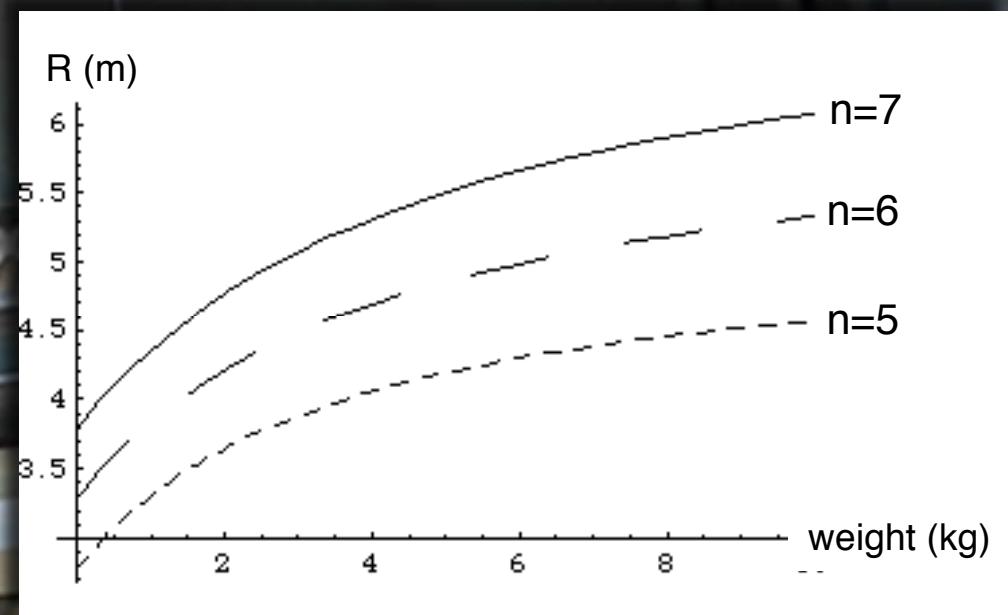
Multiple ^{60}Co source, primarily for vertex reconstruction



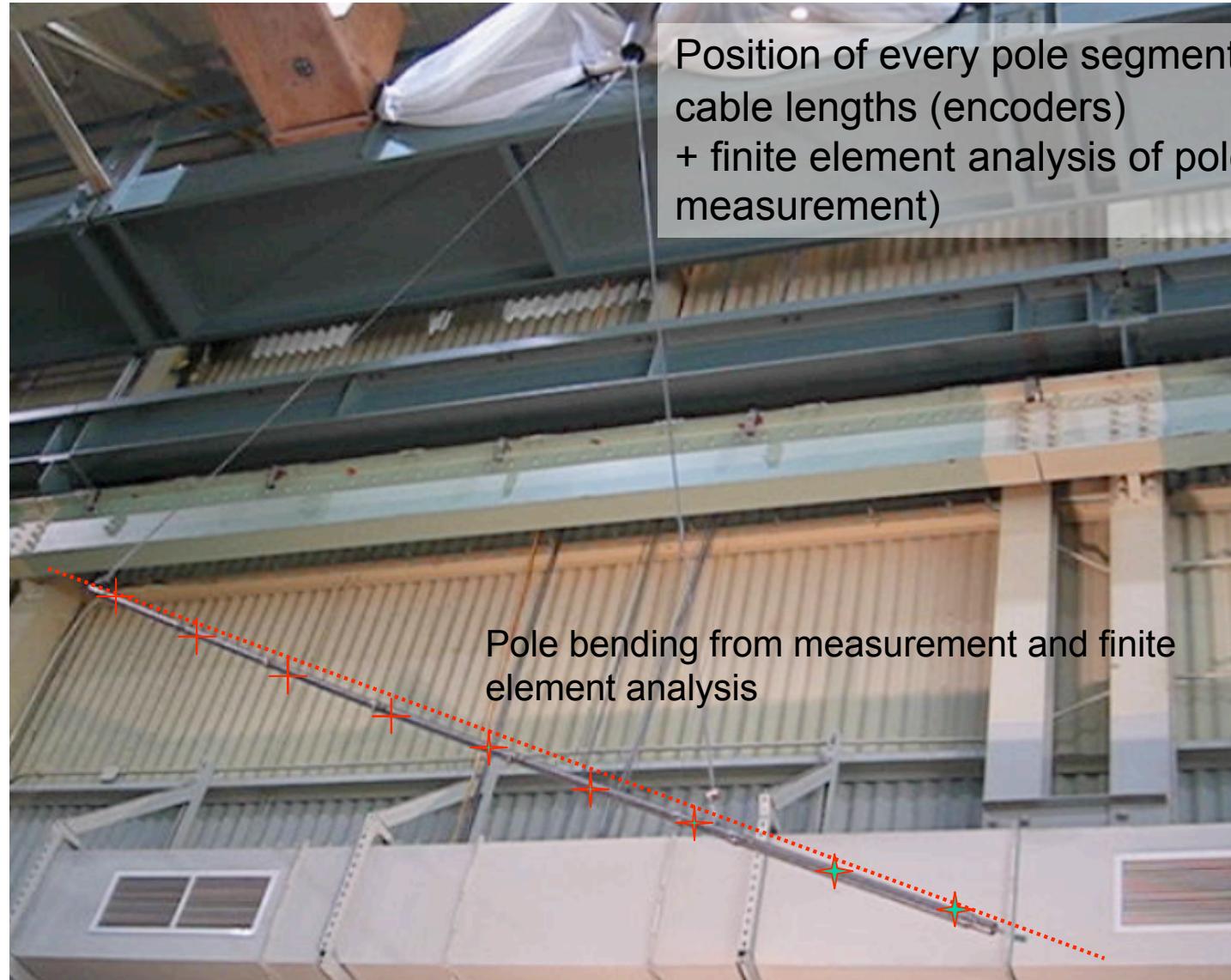
calibration in semicircles
duration: ~1 semicircle/shift

12 points = ~ 6-8hrs of data taking

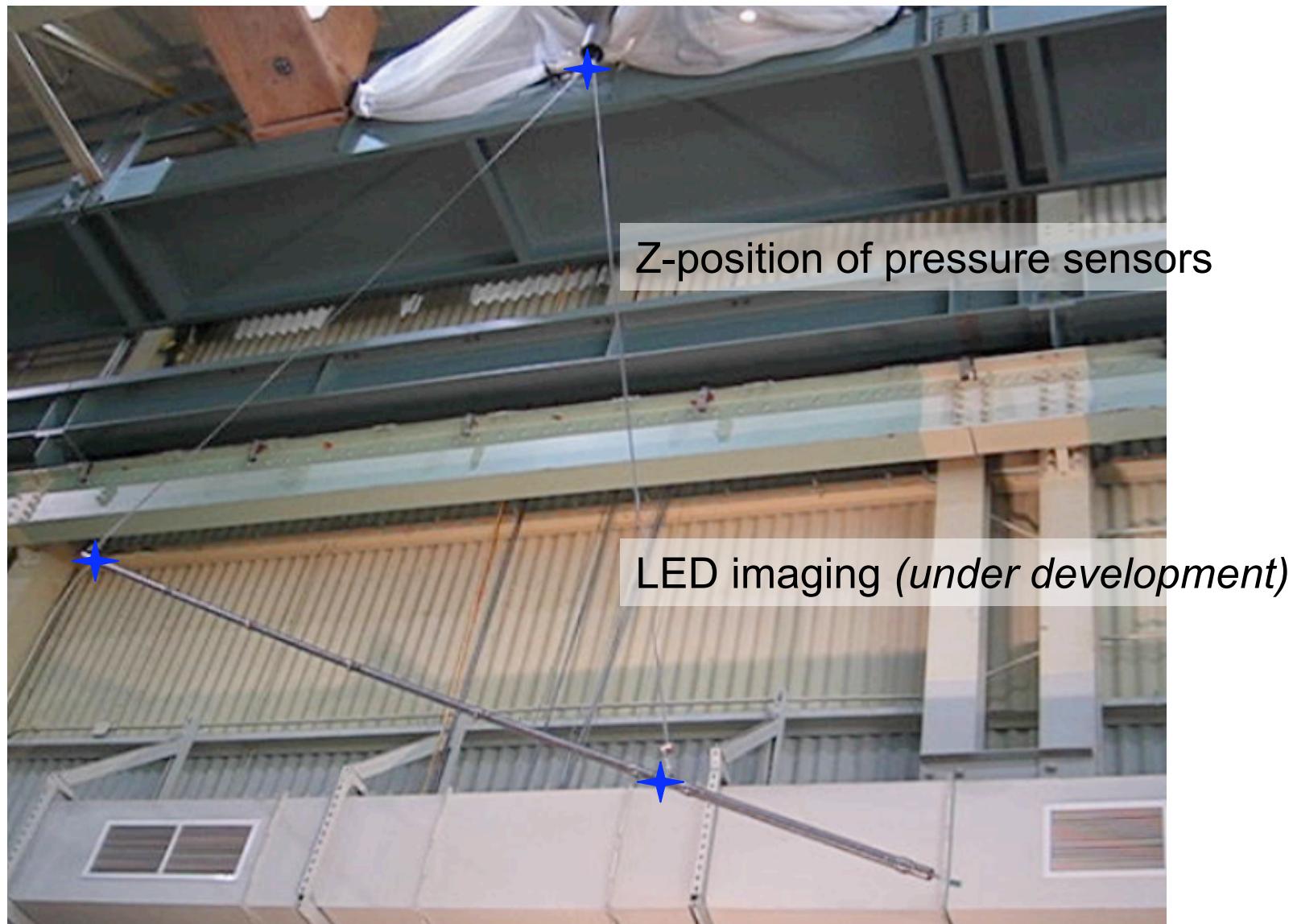
Radial Reach



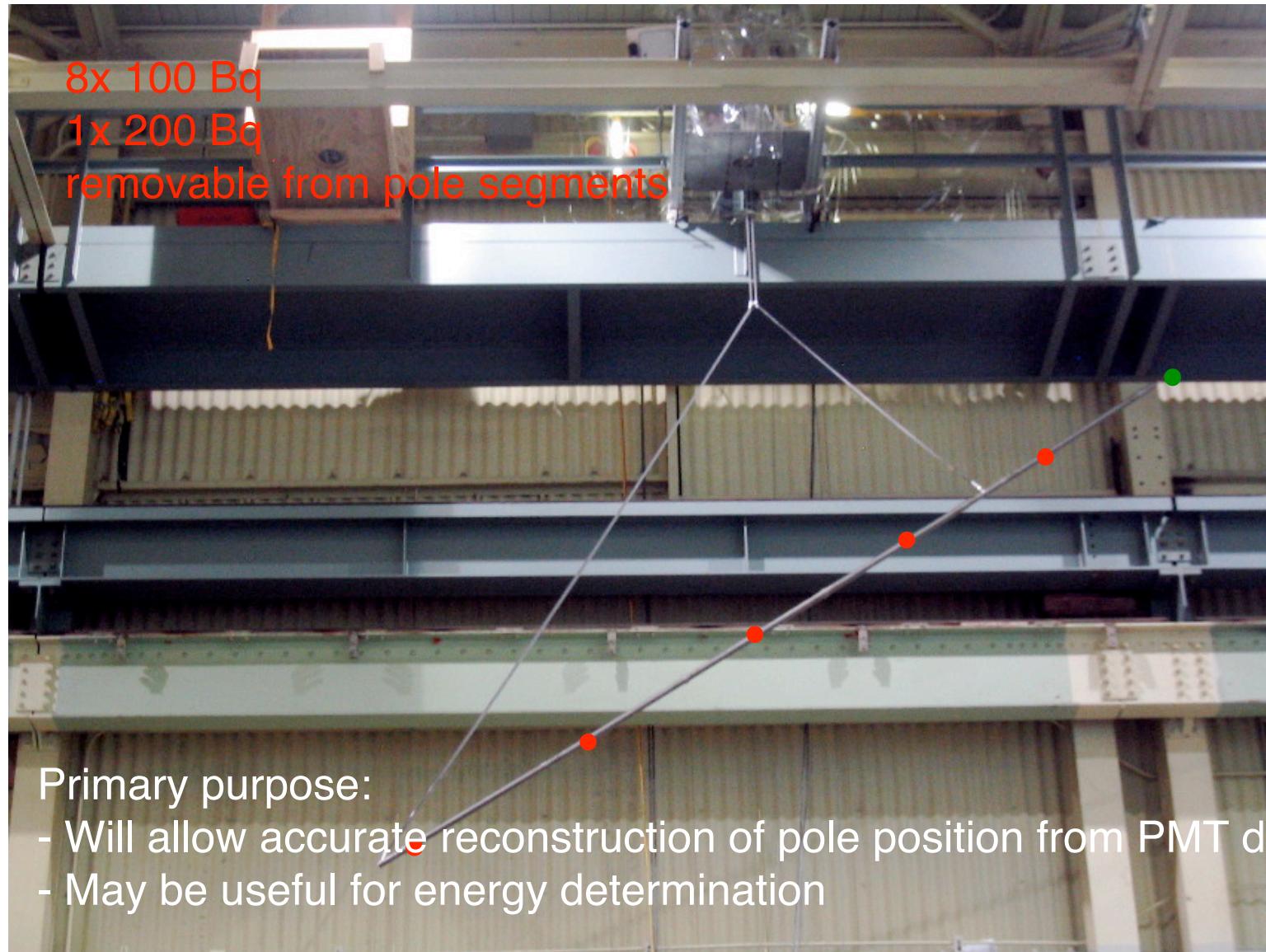
Position and Geometry Information



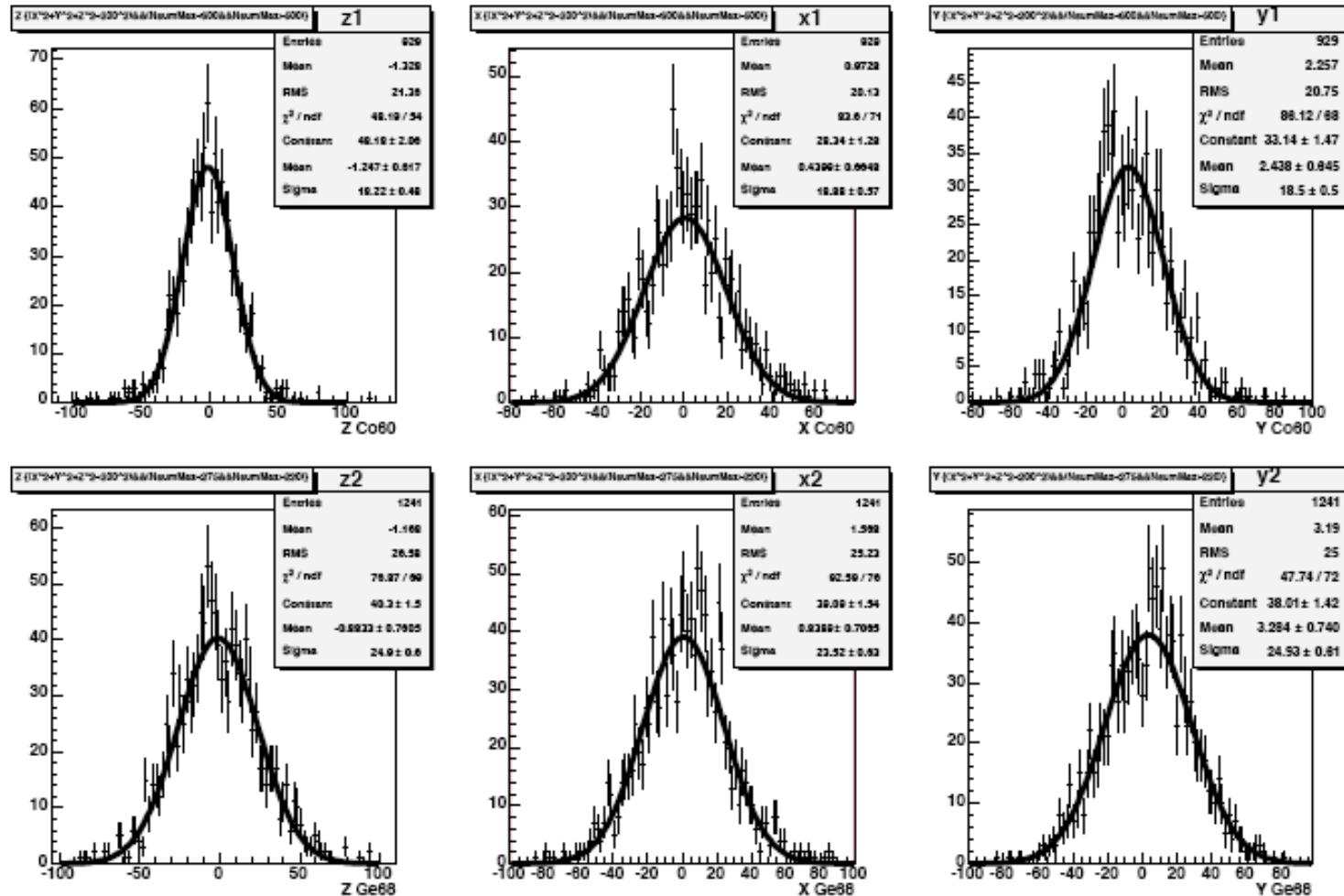
Position and Geometry Information



Removable ^{60}Co Sources in Every Pole Segment



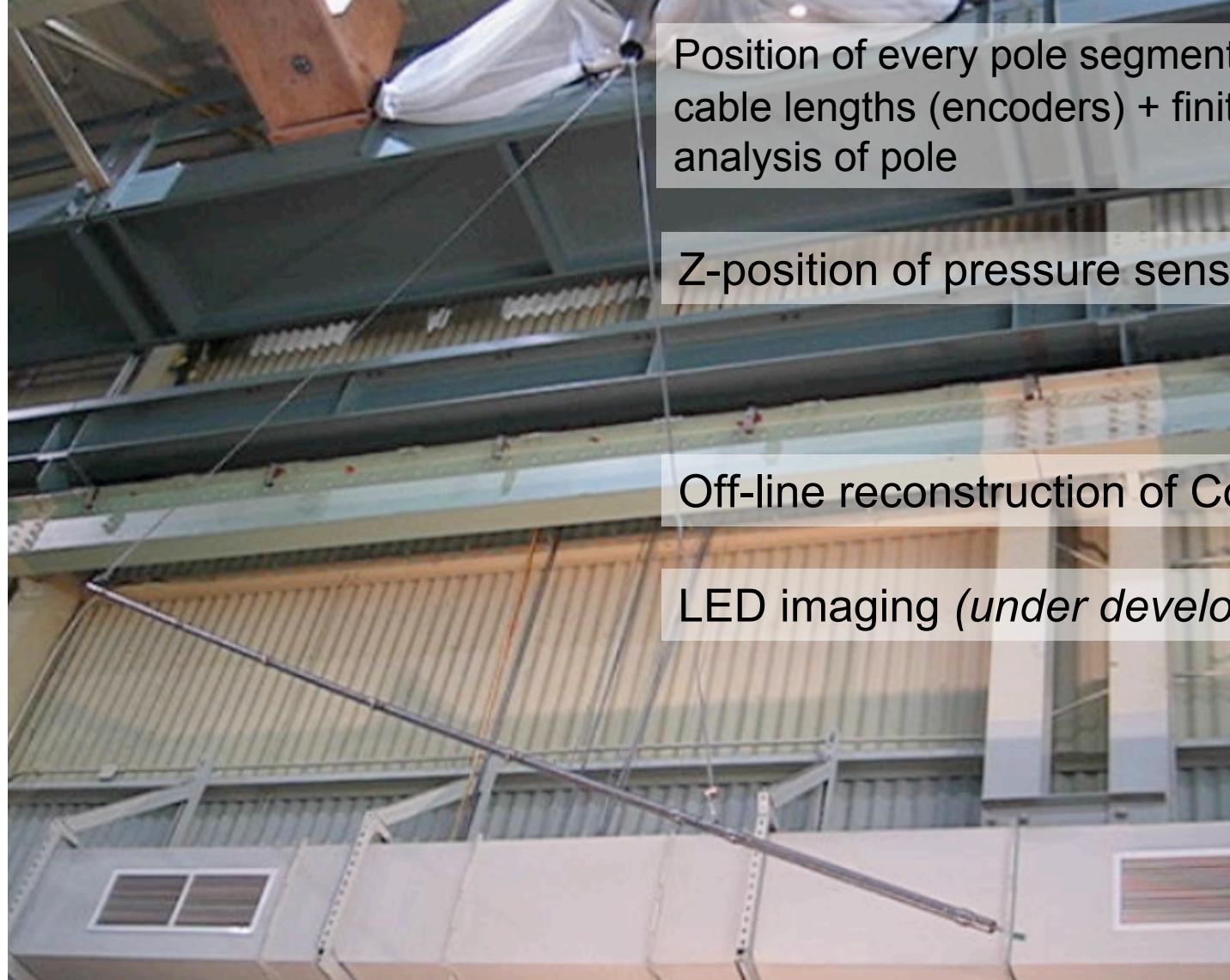
Offline Reconstruction of ^{60}Co Sources

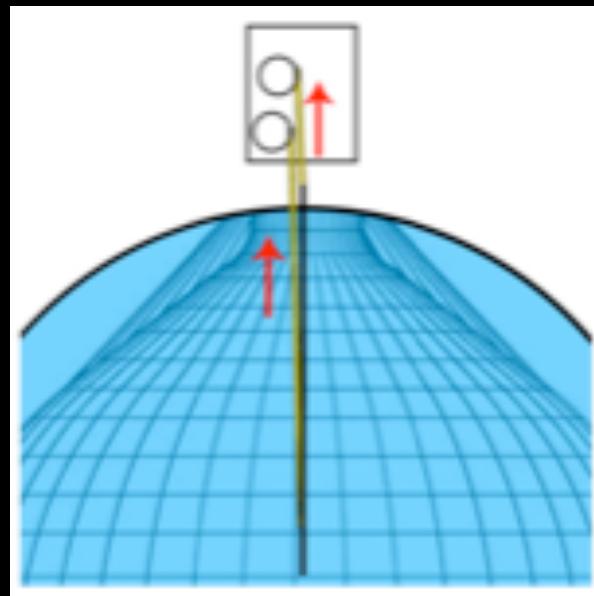


T. Classen

Figure 1: run 4398 position reconstruction, approximately 1000 Co-60 events

Determination of Source Position





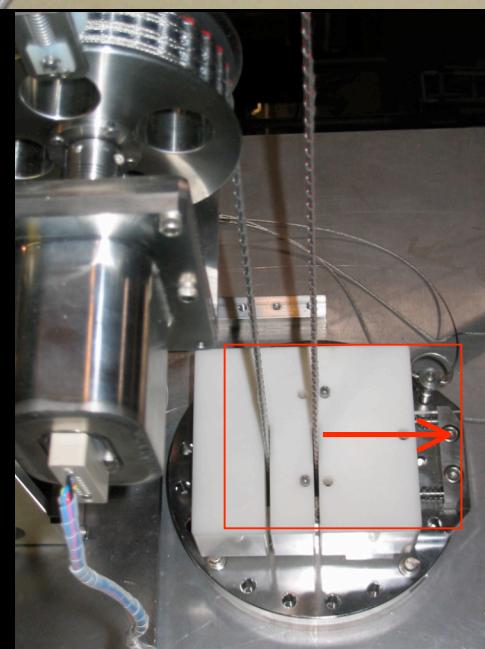
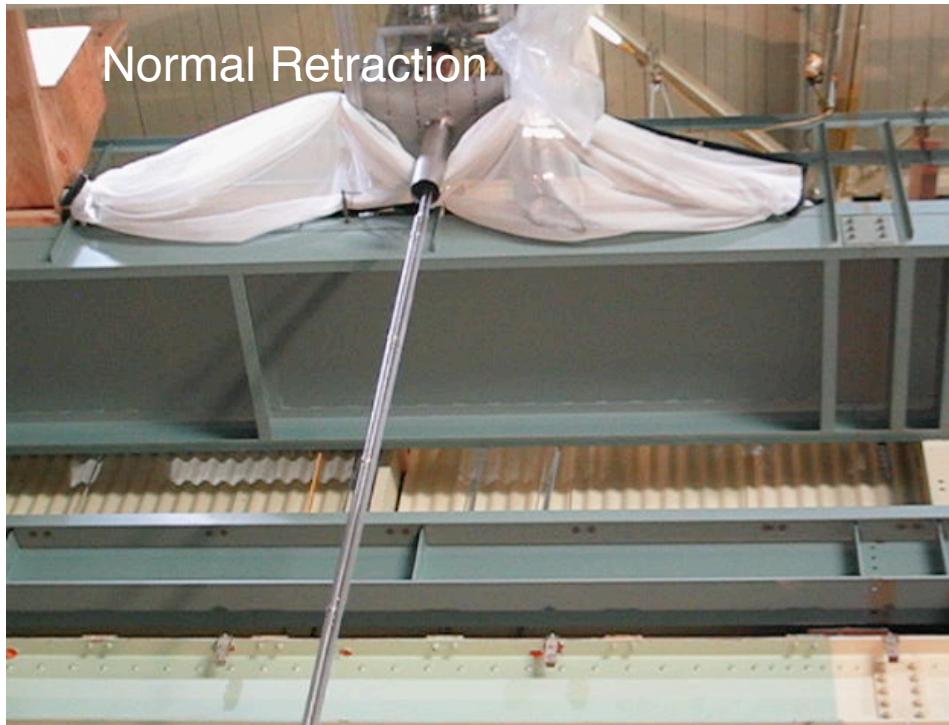
Retraction

Normal Retraction

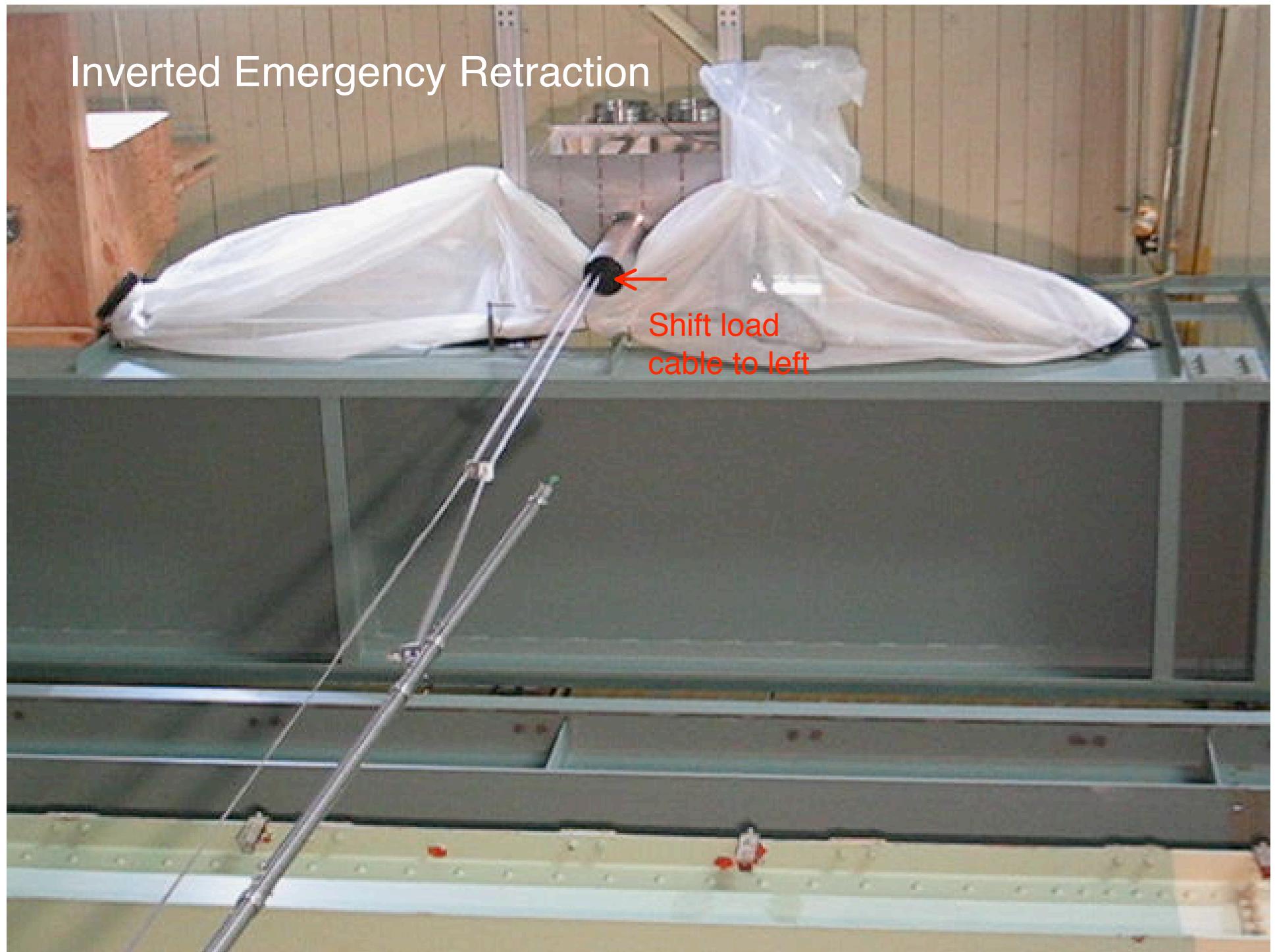
↓ source pointing downwards for safety

Inverted Emergency Retraction

↑ source pointing up in case one motor fails



Inverted Emergency Retraction



Inverted Retraction



Commissioning Plan

Day 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

